



# Forest Insect & Disease Management

Evaluation Report

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AN AERIAL SURVEY OF DEFOLIATION AND MORTALITY CAUSED BY  
THE SPRUCE BUDWORM IN THE UPPER PENINSULA OF MICHIGAN -  
1976 WITH MANAGEMENT CONSIDERATIONS

by

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## INTRODUCTION

The current spruce budworm, *Choristoneura fumiferana* (Clem.), outbreak in the Upper Peninsula of Michigan began in the late 1960's. Defoliation of balsam fir and white spruce was first reported in Luce and Marquette counties and on the Hiawatha National Forest in Mackinac and Chippewa counties. The outbreak spread rapidly from these focal points. The first reports of balsam fir mortality were from Mackinac and Chippewa counties in 1971.

During the early and mid-1970's, budworm caused defoliation and tree mortality continued to spread. Presently, the majority of the spruce-fir type in the Upper Peninsula is involved in some stage of the outbreak. While the outbreak has subsided in some of the original areas because of host depletion, it also continues to move into new areas.

Aerial surveys have been conducted on parts of the Upper Peninsula in the past. But this is the first complete survey of the entire Upper Peninsula.

## OBJECTIVE

The purpose of this cooperative survey is to provide land managers with a map and report of spruce budworm-caused defoliation and tree mortality on all land ownerships. The report also contains management considerations as an aid in setting priorities when making management decisions.

## METHOD

A standard low-level sketch mapping aerial survey was used. Flights were made in late June at the peak of defoliation. Flights for the eastern half were made from Sault Ste Marie by D. G. Mosher, Michigan DNR and A. R. Hastings, U. S. Forest Service. Flights for the western portion of the peninsula were from Land-O-Lakes, Wisconsin by Bruce Anderson, Forest Technician, St. Paul and Marion True, Timber Management Staff, Ottawa National Forest, Ironwood, Michigan.

NORTHEASTERN AREA, STATE & PRIVATE FORESTRY  
USDA FOREST SERVICE, UPPER DARBY, PA 19082



All flight lines were drawn on County or Forest Recreation Maps (U. S. Forest Service) to cover the major spruce-fir forest type. We were able to separate defoliation and tree mortality into three classes:

1. Light to Moderate--up to 50% defoliation;
2. Heavy--50% or more defoliation with no observable top-kill or tree mortality;
3. Severe--50% or more defoliation with obvious top-kill and tree mortality.

Each defoliation class was sketched onto the flight map using different color codes. All flight maps were then combined to make the composite map of the entire Upper Peninsula. The gross area of each defoliation class by ownership, Federal, State or Private, was computed by counting the infested sections in each class.

## RESULTS AND DISCUSSION

The total gross acreage of spruce budworm defoliation is 815,520 acres. About half is in private ownership, 29 percent in federal and 21 percent is in state ownership. A breakdown of this acreage by defoliation class and ownership is given in Table 1. The location of defoliation areas by defoliation class is shown in Figure 1.

In general top-killing begins after about 3 years during a continued spruce budworm outbreak. When the top of a mature tree has been killed, the entire tree will eventually die because of secondary invaders. Tree mortality usually begins after about 5 years. During prolonged outbreaks, (8-10 years), complete mortality of merchantable balsam fir may occur.

Certain predictions can be made, using these general rules, that can serve as a guide to land managers in setting priorities when planning salvage operations.

In light to moderate defoliated stands, top-killing and tree mortality can be expected to start in about 3 to 5 years. Some mortality may occur earlier in suppressed or severely stressed trees.

In the heavy defoliation class, significant top-killing and tree mortality can be expected within 1 to 3 years.

Top-killing and tree mortality are already present in the severe defoliation class. Mortality will accelerate rapidly where budworm populations persist. Tree mortality can be expected to continue for several years even if budworm populations collapse.

## MANAGEMENT CONSIDERATIONS

Management decisions concerning harvesting and salvage operations will obviously be limited by market conditions. When markets do exist, the following factors should be considered when setting priorities for cutting operations. These factors are not necessarily listed in order of importance. But stand condition should be given primary consideration.



1. Condition of stand.

Severe defoliation class: These stands should be given first priority because mortality is already present. Stands in this class should be inspected individually to determine if a merchantable volume still exists.

Heavy defoliation class: These stands should be given second priority for salvage. If action can be taken soon enough, then most of the volume in these stands can be utilized.

Light to moderate defoliation class: These stands should be considered last. Sufficient time remains to harvest these stands before serious losses begin.

2. Age of stands.

The oldest stands should be cut first. These stands will begin to break up first, especially on poor sites.

3. Stand composition.

Those stands with the highest component of balsam fir should be given first priority. Stands with a high component of white spruce are more resistant to damage.

4. Stand volume.

Take stands with the highest potential volume loss first.

5. Site.

Stands on poor sites will be damaged earlier and to a greater extent than those on better sites.

Table 1.--Gross Acreage of Spruce Budworm by Defoliation

Class and Land Ownership - 1976.

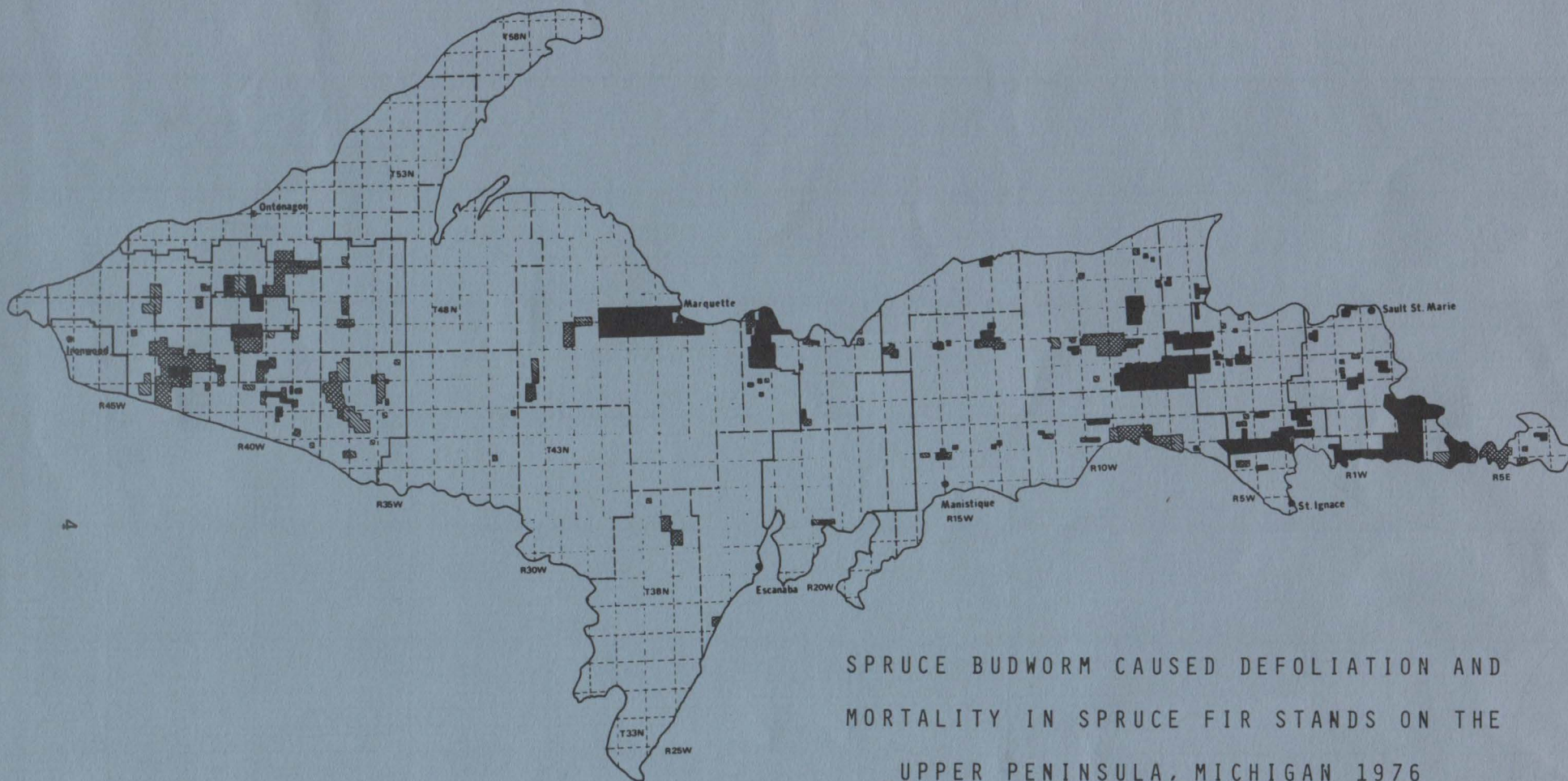
Defoliation Class <sup>1/</sup>	Land Ownership			Totals
	State	Private	Federal	
Light to Moderate	12,160	41,920	41,920	96,000
Heavy	57,920	152,160	133,760	343,840
Severe	98,560	213,120	64,000	375,680
TOTALS	168,640	407,200	239,680	815,520

<sup>1/</sup> Light - indicates up to 50 percent defoliation

Heavy - 50 percent or more defoliation with no observable top-killing or tree mortality.

Severe - 50 percent or more defoliation with top-killing and tree mortality.





SPRUCE BUDWORM CAUSED DEFOLIATION AND  
MORTALITY IN SPRUCE FIR STANDS ON THE  
UPPER PENINSULA, MICHIGAN 1976

KEY

- SEVERE DEFOLIATION, TOPKILL  
AND TREE MORTALITY
- ▨ HEAVY DEFOLIATION (50% OR MORE)
- ▧ LIGHT TO MODERATE DEFOLIATION  
(LESS THAN 50%)

- - - COUNTY LINE
- TOWNSHIP/RANGE
- NATIONAL FOREST  
BOUNDARY